The Impact of Universal Stock Futures on Feedback Trading and Volatility Dynamics

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Abstract: This paper investigates the impact of the introduction of Universal Stock Futures (USFs) on underlying market dynamics (volatility and the level of feedback trading). Analysis of USFs provides a number of advantages compared to investigation of index futures, leading to reliable and wider ranging insights into the impact of derivatives. Specifically: (i) any impact of derivatives is more likely to be evident in the behaviour of individual stocks; (ii) with USFs it is possible to directly trade the underlying; (iii) USFs have multiple introduction dates within a given market; (iv) differential country/industry effects can be identified; and (v) endogeneity issues can be addressed using control stocks. Findings suggest limited feedback trading in USF stocks, but listing has reduced this further. While news has less impact and persistence and asymmetry effects are more evident post-futures, control stock results suggest these changes are not futures induced. Differences are evident across industries. The need for analysis of an appropriate (industry based) control sample is highlighted if reliable policy conclusions are to be reached.

Keywords: Futures Listing, Feedback Trading, Volatility Dynamics, Universal Stock Futures

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1. INTRODUCTION

In spite of extensive research, concern about whether derivatives influence the underlying market cannot be resolved at the theoretical level, since changed volatility can result either from (de)stabilising speculation or improved information flows. By investigating both the extent of serial correlation of returns and the nature of volatility pre- and post-futures more reliable conclusions can be drawn about whether further regulation of derivatives, such as higher margins, narrow price fluctuation limits and restrictions on the issue of contracts, is justified. To this end Antoniou et al. (2005) examine the effect of futures on a range of indices utilising Sentana and Wadhwani's (1992) (hereafter, SW) heterogeneous trader model.[1] The model allows consideration of the consequences of derivatives not only on underlying volatility, but also on the extent to which futures inhibit or promote feedback trading in the cash market. Antoniou et al. (2005) find that index futures reduce the impact of feedback traders. However, their analysis is limited to the effects of trading index futures in six countries, with only one event date in each country. As McKenzie et al. (2001) point out, studies of stock indices are useful in assessing market-wide impacts, but any effect on the underlying can be dissipated across the many constituent stocks in the index, making the true effect difficult to detect. In addition, unlike stocks, the index itself cannot be directly traded.[2] Hence, the influence of futures on feedback trading and volatility might be more noticeable at the individual stocks level.[3] Indeed, concern that single stock futures (SSFs) might have an adverse impact on the underlying has led to tighter restrictions on such instruments than on index futures.[4]

[1] Sentana and Wadhwani (1992) investigated stock returns for the US using this model. It has also been used to examine the stock returns in a range of other markets. See, for example, Koutmos (1997), Koutmos and Saidi (2001) and Bohl and Reitz (2006).

[2] Exchange traded funds, which represent a claim on the index basket, can be traded directly.

[3] In addition to the argument about effects being dissipated across stocks, it is also the case that any particular stock is less liquid than the index and, hence, the impact of derivatives could be greater.

[4] For example, in the US futures on individual stocks were banned for 20 years under the Shad-Johnson Accord and such trading only began in the US in November 2002.

SSFs were introduced on the London International Financial Futures and Options Exchange (LIFFE[5]) in January 2001 with the introduction of Universal Stock Futures (USFs).[6] USFs are contracts whose underlying securities are individual shares of some of the world's largest companies traded in a range of different markets. LIFFE was the first exchange to launch 'cross-border' SSFs. While USFs are important additional instruments for investors, since they allow a better match for investment and risk management purposes than do broad based index futures or domestic SSFs,[7] concerns about their impact on the underlying market remain. It is, therefore, important and informative to investigate the extent to which USF trading has changed the characteristics of the first and second moment of returns in the stock market. This paper addresses this issue in detail using the SW model. Consideration is given to both feedback trading and volatility, including the asymmetric response of volatility to news on a stock by stock basis. Given the significance and unique characteristics of USFs, this market provides a key opportunity to investigate a range of issues not previously addressed. In addition to futures-induced effects being easier to identify for SSFs, there are multiple introduction dates for USFs in contrast to index futures, and contracts are listed on stocks traded in a range of markets each with different characteristics.[8] Hence, it is possible to determine if these characteristics influence the impact on the underlying.[9] In addition, the impact of foreign-listed futures on their domestic underlying stock markets can be investigated with USFs and it is possible to examine whether the impact of futures differs across industries. Importantly, it is also possible to consider how market dynamics

[5] Following the purchase of LIFFE by Euronext in January 2002, LIFFE became part of Euronext.liffe, comprising of the Amsterdam, Brussels, LIFFE, Lisbon and Paris derivatives markets. For convenience we use the term LIFFE throughout the paper to refer to either LIFFE or Euronext.liffe.

[6] SSFs were traded on some smaller exchanges such as the Sydney Futures Exchange prior to 2001, but the level of trading in these contracts was relatively low.

[7] For example, USFs allow individual components of a portfolio to be hedged without having to change the portfolio and they also offer tax benefits (e.g. they are exempt from stamp duty for UK stocks due to them being cash settled).

[8] With only one event date it is possible that other market-wide factors which occurred at about the same time as the introduction of futures trading may affect the results.

[9] Harris (1989) suggests that stock option/futures listing do not impact uniformly on the volatility of the underlying. He argues the effect of listing will depend on: i) the sophistication of market participants; ii) the existence of constraining regulations such as prohibition of short selling; and iii) the liquidity of the markets. Possibly for these reasons, authors, such as Damodaran and Lim (1991) and Bollen (1998) suspected that options may have a differential impact in different trading locations. Their empirical evidence supports this.

have changed over the sample period for a control sample of individual stocks, in a way not feasible for index futures. By first modelling the listing decision for USFs and basing the choice of the control sample on this model, it is possible to overcome potential endogeneity issues inherent in previous studies. Hence, conclusions drawn are more robust. Thus, investigation of the introduction of USFs should provide important and reliable insights about the extent to which futures trading affects the market dynamics of the underlying and, hence, whether further regulation is warranted. In addition, the results should be of interest to both developed and emerging markets considering introducing SSFs.

The rest of the paper is organised as follows. The next section briefly discusses literature on the impact of futures trading, sets out the main features of the feedback trading model and identifies hypotheses to be tested. The third section discusses the methodology for selecting a control sample and the data. Results are then presented and the final section concludes the paper.

2. FUTURES TRADING, THE UNDERLYING MARKET AND FEEDBACK TRADING

Concern over derivatives predates the introduction of financial futures, but arguably has intensified since stock based futures were introduced in 1982. The main argument levelled against futures is that they attract destabilising speculators, leading to increased stock market volatility, a perception of higher risk and a higher cost of capital which impacts on the wider economy.[10] However, following the work of Ross (1989), it is acknowledged that increased volatility may be the result of greater information flows rather than necessarily resulting from destabilising speculation (see, for example, Antoniou and Holmes, 1995; Chatrath and Song, 1998). Hence, based on theoretical considerations alone it is not possible to reach unambiguous conclusions about the impact of futures on underlying market volatility and, more importantly, about the causes of any changes in cash market volatility. Rather, conclusions can only be drawn after appropriate empirical analysis.

[10] Futures are seen to be attractive to speculators because of the relatively low transactions costs, trading on margin (which offers leveraged positions), ease of closing out the position and cash settlement, rather than physical delivery, in the case of most stock based futures.

More recently, the impact of noise and other non-rational traders on the underlying's volatility following the introduction of futures trading has been examined. See, for example, Antoniou et al. (1998) who examine the asymmetric response of volatility to news and Antoniou et al. (2005) who take account of feedback trading and investigate how both volatility and serial correlation of returns change post-futures. They argue that "If derivative markets were to attract noise traders in general and positive feedback traders in particular, then the potential for destabilization would be real and the claim for further regulation warranted." (Antoniou et al., 2005, p.221). By examining the extent to which futures promote/inhibit feedback trading, it is possible to determine whether changes in market dynamics are due to improved information flows or result from destabilising speculation. While there is a vast literature examining the impact of equity derivatives trading on the underlying stock market, most of the evidence comes from studies of either stock index futures or single stock options and the results of previous studies are mixed.[11] To date, SSFs have been subject to very little attention in the academic literature.[12] Of the studies which have been undertaken on the impact of SSFs on volatility, none examine the impact of feedback trading and most concentrate on less liquid markets.[13]

(i) The Heterogeneous Trader Model

SW model the behaviour of both 'smart money' investors who respond rationally to expected returns subject to wealth limitations and feedback traders who react to previous price changes rather than basing their investment decisions on fundamental value. The demand for stocks by feedback traders (F_t) is modelled as equation (1):

[11] See, for example, Edwards (1988a, 1988b), Hodgson and Nicholls (1991), Choi and Subrahmanyam (1994), Antoniou and Holmes (1995), Antoniou et al. (1998), Bollen (1998), Gulen and Mayhew (2000), Rahman (2001), Board et al. (2001) and Antoniou et al. (2005). For a comprehensive summary of a large number of theoretical and empirical studies of the effect of index futures on stock market volatility, see Sutcliffe (2006), chapter 12.

[12] Exceptions include Lee and Tong (1998), Dennis and Sim (1999), McKenzie et al. (2001), Lien and Yang (2003), Ang and Cheng (2005a, 2005b) and Shastri et al. (2007).

[13] For example, McKenzie et al. (2001) examined individual share futures (ISFs) traded in Australia. During the period analysed the annual volume of ISFs contracts traded declined from 111,696 in 1995 to 8,646 in 1998. For USFs the number of contracts traded annually increased from 2.33 million in 2001 to over 18 million in 2006.

$$F_t = \gamma R_{t-1} \tag{1}$$

where R_{t-1} denotes the return in the previous period. The value of γ allows discrimination between two types of feedback traders: $\gamma > 0$ refers to the case of positive feedback traders, who buy stocks after a price rise and sell after a price fall; $\gamma < 0$ indicates negative feedback traders, who sell after a price rise and buy after a price fall. Feedback traders of either type have the effect of moving prices away from fundamental value. Hence, if futures promote feedback trading in the cash market, then further regulation may be warranted.

The demand for stocks by rational/smart money traders (S_t) is determined by a mean-variance model (equation 2):

$$S_t = (E_{t-1}R_t - \alpha) / \mu\sigma_t^2 \tag{2}$$

where E_{t-1} denotes the expectation operator, α is the risk-free return and $\mu\sigma^2_t$ is the risk premium, modelled as a positive function of the stock price's conditional variance (σ^2_t) and μ is the coefficient of risk aversion. Equilibrium in the stock market requires that all stocks are held (equation 3)[14]:

$$S_t + F_t = 1 \tag{3}$$

Allowing the existence of both types of traders, substituting (1) and (2) in (3) and assuming rational expectations yields equation (4):

$$R_t = \alpha + \mu(\sigma_t^2) - \gamma\mu(\sigma_t^2)R_{t-1} + \varepsilon_t \tag{4}$$

where ε_t is a zero mean residual and all other terms are defined as above.

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[14] Note that if all investors are smart money/rational investors (F_t = 0), then market equilibrium (S_t = 1) yields Merton's (1973) dynamic capital asset pricing model: $E_{t-1}R_t - \alpha = \mu(\sigma^2_t)$.

In a market with both trader types the return equation contains the additional term R_{t-1}, so that stock returns exhibit autocorrelation. The pattern of autocorrelation depends on the type of feedback traders captured by γ. Positive (negative) feedback trading, $\gamma > 0$ ($\gamma < 0$), implies negatively (positively) autocorrelated returns. Furthermore, the extent to which returns exhibit autocorrelation varies with volatility, $\mu(\sigma_t^2)$. Modifying equation (4) to account for autocorrelation due to market frictions/inefficiency yields, the empirical version of the model:

$$R_{it} = \alpha + \mu\sigma_t^2 + (\varphi_0 + \varphi_1\sigma_t^2)R_{it-1} + \varepsilon_t \ ; \qquad \varepsilon_t \sim GED(0, \sigma_t^2) \qquad (5)$$

where R_{it} is the day t return of the underlying stock i. σ^2_t is conditional variance of returns at t, and ε_t is a zero mean residual which has time-varying variance σ^2_t. The residual is assumed to follow a Generalised Error Distribution (GED) in order to accommodate any non-normality. The coefficient φ_0 captures autocorrelation induced by potential market frictions/thin-trading. The coefficient $\varphi_1 = -\gamma\mu$. A statistically significant and negative (positive) φ_1 implies positive (negative) feedback trading.

The model is completed using a GARCH specification for the conditional volatility of the error term in equation (5), with the main analysis based on the GJR-GARCH (1,1) model as specified by equation (6):[15]

$$\sigma_t^2 = \alpha_0 + \alpha_1\varepsilon_{t-1}^2 + \beta\sigma_{t-1}^2 + \delta X_{t-1}\varepsilon_{t-1}^2 \qquad (6)$$

where σ^2_t is the conditional volatility at time t, ε_{t-1} is the innovation at time t-1 and X_{t-1} is a dummy variable which assumes a value of one in response to bad news ($\varepsilon_{t-1}<0$) and zero in response to good news ($\varepsilon_{t-1}\geq 0$). If δ is positive and statistically significant, it indicates that a negative shock has a greater impact on future volatility than a positive shock of the same size. α_1

[15] Extensive tests were conducted to determine the most appropriate GARCH specification. The symmetric model was compared with the two asymmetric models of Glosten et al. (1993), (GJR-GARCH), and Nelson (1991), (EGARCH). The asymmetric models performed best, with GJR-GARCH performing better than EGARCH. Results of specification tests are available on request.

is the news coefficient and captures the impact of the most recent innovation, while β is a measure of persistence. α_0 represents unconditional volatility.

(ii) Hypotheses Development and Testing Method

The model described in equations (5) and (6) is estimated for both pre-futures and post-futures periods and comparisons are made of the estimated coefficients. Specifically, with respect to equations (5) and (6) we test the null hypotheses that there is no difference between the pre- and post-futures periods in relation to the coefficient relating to feedback trading, $\varphi_{1,}$ that relating to the constant component of autocorrelation, φ_0, and the coefficients which describe the conditional volatility of returns, α_0, α_1, β and δ. If futures lead to an improved information flow, an associated improvement of informational efficiency and a reduction in the impact of feedback and other noise traders, then the null hypotheses will be rejected. In such circumstances, we expect a reduction in φ_1, φ_0, δ and β and an increase in α_1. On the other hand, if futures are destabilising and promote feedback trading the opposite is expected. α_0 represents unconditional volatility. If the introduction of USFs causes structural changes in the dynamics of the underlying stocks, a significant change in the value of α_0 is expected. We also examine differences in findings for USFs written on stocks listed in different countries and in different industries.

Factors other than futures trading may affect the coefficients considered in our tests. For example, market-wide changes that altered the dynamics of the market may have occurred around the time of the USF introduction dates. Tests may erroneously attribute such a change, if it occurred, to the introduction of USFs. To ensure the reliability of any conclusions and policy implications drawn from empirical analysis, it is necessary to implement a control procedure to account for these possible sources of bias. Thus, equations (5) and (6) are also estimated for a sample of control stocks on which USFs are not written. USF stocks may have futures written on them *because* of their characteristics in the pre-listing period. Thus, even using a control sample may fail to provide a true test of robustness unless this endogeneity problem is addressed. Therefore, the control sample is chosen by identifying the ‘nearest-neighbour’ stocks that were eligible, but not selected for futures listing, using the procedure outlined in the next section. If USF stocks behave differently to control stocks, then conclusions drawn with respect to the impact of futures introduction are strengthened.

3. DATA AND THE CHOICE OF CONTROL STOCKS

LIFFE began trading 25 USFs on January 29, 2001. Each USF contract represents 100 shares of the underlying stocks, except contracts written on UK and Italian based stocks which represent 1000 stocks. The volume of contracts traded increased rapidly from 2.3 millions in 2001 to over 18 millions in 2006.

(i) The USF Sample

Sample selection involved identifying all stocks with USFs listed in 2001.[16] The sample is restricted to such stocks because being the earliest listed USFs it is believed that these might have a more prominent impact (if any) on the underlying market than USFs listed later.[17] The only stocks included are those with futures first introduced on LIFFE and not listed in any other futures exchange within the sample period. Including stocks which have futures traded in their domestic markets would make it difficult to identify the effect of USF listing.[18] To be selected, a stock must also have daily price data for the whole sample period.[19] In total, 80 USF stocks survive these criteria. Daily closing stock prices are obtained from Datastream for a period of three years prior, to three years after the USF listing of each stock, yielding in excess of 750 observations per stock for each sub-period. Returns for each stock are the first difference of the log-price.[20]

[16] In 2001 USFs were listed in January, March, April, May and October.

[17] Furthermore, while additional USFs have been listed subsequently, the major wave of listings took place in 2001.

[18] For example, since LIFFE introduced USFs, the Finland Helsinki Stock Exchange started trading SSFs on Nokia. In order to avoid interpretation problems, this particular stock was excluded from the empirical analysis.

[19] Some USFs were delisted during the sample period due to thin trading of the futures or corporate changes such as M&A.

[20] This excludes dividends, consistent with previous literature examining feedback trading, since such trading is based on historical price movements rather than total returns. However, for robustness, comparisons have been made of summary statistics of portfolio returns and results for country and industry portfolios using returns defined both with and without dividends. Such comparisons are discussed below and results are qualitatively similar.

(ii) Selection of Control Stocks

To select control stocks, analysis is undertaken of the futures listing choices by LIFFE to explicitly account for endogeneity issues. The relative importance of various firm-specific trading characteristics influencing the exchange's listing choice is examined using a logit model similar to that of Mayhew and Mihov (2004) and Ang and Cheng (2005a) who successfully modelled the selection for derivatives listing in the US. The logistic regression, as shown in equation (7), is used as the basis for estimation:

$$\log\left(\frac{p}{1-p}\right) = \alpha_0 + \alpha_1 VOL + \alpha_2 STD + \alpha_3 SVOL + \alpha_4 SSTD + \alpha_5 SIZE + \alpha_6 MKT + \alpha_7 IND + \varepsilon \quad (7)$$

The dependent variable is the log-odds ratio of being selected for USF listing. p is the probability of being selected and is less than 1. If a stock is picked for futures listing by LIFFE, the listing dummy is 1, otherwise it is 0. VOL is daily average trading volume over the 250 trading days prior to the listing month. STD is standard deviation of daily stock returns over the same period. SIZE is market capitalisation of the firm at the month end prior to the listing month. The variables SVOL and SSTD are ratios of 30-day to 250-day average daily trading volume and standard deviation, which are used as proxies for short-term volume and volatility relative to volume and volatility within the year prior to the listing months. MKT and IND are market and industry indicators used to test whether trading location and industry group affect the probability of a stock being selected for futures listing. Equation (7) is estimated for a pooled dataset of daily observations for all stocks classified as eligible for futures listing, but which had not yet been listed.[21]

Following estimation of the logistic regressions, the predicted probability of being listed for each eligible stock at each listing date is generated (i.e. the propensity-score). Control stocks are selected by choosing those in the same market and industry as their USF counterpart which match the USF sample as closely as possible in terms of propensity-score (i.e. the 'nearest-

[21] All stocks from the local benchmark index (for example the FTSE-100 for the UK) which did not have futures listed on them at the time of each listing month were classified as eligible stocks. All stocks, both USF and control, included in the analysis were constituents of an index on which futures contracts were written.

neighbour'). To be selected, control stocks must not have any futures listed at any time within the subsequent three year period and stocks already included in the control sample are excluded from subsequent consideration. Results (table 1) suggest the four versions of logistic regression model estimated capture the selection process well, with 82%-86% of stocks correctly classified. Model A performs best and control stocks are selected using the propensity-score from this model.[22]

INSERT TABLE 1 ABOUT HERE

(iii) Summary Statistics

Table 2 provides summary statistics for portfolios of USF and control stocks, based on country (panel A) and industry (panel B). Estimates for stocks based in the UK, US, France, Germany and other countries are reported.[23] The table shows the mean (μ), standard deviation (σ), measures of skewness (S) and excess Kurtosis (K), Jarque-Bera test of normality (JB), ARCH test and Ljung-Box statistic (LB) for 5 lags. Significant departures from normality and ARCH effects are evident across all portfolios (USF and control). The LB statistics show evidence of temporal dependencies in the first moment of the returns' distributions in more than half of all portfolios, while for squared returns, the LB statistic is significant in all cases. To examine the extent of interrelationships between autocorrelation and volatility, further investigation is required.[24]

INSERT TABLE 2 ABOUT HERE

[22] Compared to the 'characteristics matching' method, choosing control stocks by this 'propensity-score matching' approach is more likely to correct for the possible bias due to both endogeneity of futures listing and changes in market-wide trends. See, for example, Mayhew and Mihov (2004). In addition, Cheng (2003) also presents a detailed comparison of these two types of matching approaches.

[23] To avoid reporting statistics and results for portfolios containing only a small number of stocks, a composite portfolio (referred to as 'Others') is created for USF stocks traded in Italy, the Netherlands, Spain, Sweden and Switzerland. As well as having the smallest number of USFs written on their stocks, these markets represent the smallest markets in the sample in terms of market capitalisation.

[24] A comparison of figures in table 2 with those based on the total return (including dividends) shows that while the mean return is higher for total returns, all other distributional characteristics are almost identical.

4. EMPIRICAL RESULTS

To address the main research question relating to the impact of trading in USFs on the underlying market dynamics equations (5) and (6) are estimated for the 80 USF stocks in the sample for pre- and post-futures periods separately.[25] The same 160 estimations are undertaken for the 80 control stocks.[26]

INSERT TABLE 3 ABOUT HERE

Tables 3, 4 and 5 summarise the results of the maximum likelihood estimates of the empirical version of the feedback model, allowing for asymmetric responses of volatility to news (i.e. equations (5) and (6)) for both USF and control stocks.[27] Summary results relating to the six key coefficients (φ_0, φ_1, α_0, α_1, β and δ) are reported.[28] The mean values of each of the coefficients in the pre- and post-futures periods are reported in table 3 and are generally consistent with those reported in previous studies (see, for example, Antoniou et al., 2005, Koutmos, 1997, 2002, and Bohl and Reitz, 2006). Panels A and B relate to USF and control stocks respectively. Within each panel results are reported firstly for the whole sample (sub-panels A1 and B1) and then for stocks sorted by country (A2 and B2) and by industry (A3 and B3).[29] To allow a distinction to be drawn between negative and positive feedback tradings, results are reported separately for positive values of φ_1 (negative feedback trading) and negative values of φ_1 (positive feedback

[25] The method of estimation used in this paper is based on the Berndt et al. (1974)'s algorithm.

[26] The results of these estimations are summarised in a number of tables, rather than presenting the results of all 320 estimations separately. Results of individual estimations are available on request.

[27] Given the earlier evidence of non-normality, estimation is undertaken under the assumption that the error term follows a GED to overcome the problem that in the presence of non-normality, standard t-tests are unreliable.

[28] A battery of specification/goodness of fit tests were undertaken and showed that the standardised residuals fulfil the requirements of zero mean and unit variance and show a general absence of autocorrelation and ARCH effects. In addition, the diagnostic tests of Engle and Ng (1993) indicate the model captures a large part of the asymmetric volatility dynamics.

[29] The stocks are assigned to one of five industry groups, namely services, consumer goods, technology, financial and general and resources based on the Datastream industry classification definitions.

trading). For the whole sample the table also reports the results of the non-parametric Kruskal-Wallis test examining whether the coefficients in the post-futures period are significantly different from the pre-futures period.[30] As table 3 shows, the post-futures mean is significantly different from the pre-futures mean value at the 1% level in all cases for USF stocks with the exception of δ (where there is a significant difference at the 10% level) and φ_1 (positive). This provides prima facie evidence that USF trading may have impacted on underlying market dynamics. If futures trading has led to improvements in information flows and a reduction in feedback trading, then we would expect that in the post-futures period there would be an increase in α_1, a reduction in β and δ and a decrease (increase) in the value of φ_1 when φ_1 is positive (negative). While the mean values of φ_1 are consistent with this, the results in table 3 suggest that α_1 has fallen and β and δ have risen. The latter are consistent with there being destabilising speculation. However, it should be noted that a similar pattern of results is evident for control stocks; although the magnitude of changes is lower than for USF stocks and the mean value of δ is not significantly different between the two sample periods for control stocks. Nonetheless, initial findings suggest further investigations are warranted.

Table 4 shows the percentage of stocks for which each coefficient was statistically significantly different from zero (at the 5% level, using t-tests based on Newey-West standard errors) for the pre-futures and post-futures periods. The structure of this table (and of table 5) follows that of table 3. Table 5 shows the percentage of USF stocks for which the relevant coefficient post-futures was either significantly increased or significantly decreased compared to the pre-futures value, based on the Wald statistic at the 5% level.[31] In tables 4 and 5 results are again reported separately for positive and negative values of φ_1. Overall, there is clear evidence of GARCH effects with α_1 (the impact of news on volatility) being significant for USF (control) stocks in a quarter of cases (41.25%) pre-futures and β (the persistence of innovations) being significant in

[30] Tests for differences between pre- and post-futures values of the coefficients were also undertaken based on the t-statistic and Mood's median test. Results, which are available on request, are qualitatively similar. Test results are not reported for country and industry-based sub-samples due to the relatively small sample sizes

[31] The Z statistic has also been calculated to test whether a significant difference exists in the percentage of significantly changed coefficients between the USF sample and the control sample for each sub-period. These results are referred to in the text, where appropriate, and are available on request.

all cases pre- and post-futures for both USF and control stocks. In addition, the GJR-GARCH model appears generally appropriate given that for both USF and control stocks the asymmetry coefficient (δ) in the pre-futures (post-futures) period is significant in 40% (70%) or more of the estimations.

INSERT TABLES 4 AND 5 ABOUT HERE

(i) Feedback Trading

A striking feature of the results is the overall low level of feedback trading (φ_1) either pre- or post-futures. In the pre-futures period, as shown in table 4, panel A1, only 6.25% of USF stocks exhibit significant feedback trading (1.25% is negative feedback trading and 5% positive feedback trading). This falls to 2.5% for the post-futures period (of which 1.25% is negative feedback trading). This is in contrast to the evidence presented in Antoniou et al. (2005) where five out of six markets exhibit statistically significant feedback trading pre-futures. However, they also find that in the post-futures period only one market has statistically significant feedback trading. The fall in the number of stocks for which φ_1 is statistically significant post-futures suggests that, to the extent that futures trading has an impact, USFs have had a positive effect by reducing the level of feedback trading. No such reduction is found for the control stocks (panel B1) where the percentage of stocks with statistically significant coefficients is the same in each period. The findings are confirmed by the results presented in table 5, panel A1. When φ_1 is positive (negative) a significant decrease (increase) represents a reduction in the impact of feedback trading and hence, a move towards fundamental value. Table 5, panel A1, shows that in 11.25% of cases there is a significant reduction in feedback trading, while it increases in only 1.25% of cases. While a similar pattern is evident for control stocks (table 5, panel B1), the changes post-futures are less clear: 8.75% of stocks exhibit a significant decrease in feedback trading and 6.25% a significant increase in feedback trading. Thus the changes for USF stocks appear more marked, suggesting the change post-futures, while limited, is at least in part due to the onset of futures trading.

Results in relation to φ_1 in panel A2 of table 4 show that there are differences in the level of feedback trading between countries. Negative feedback trading is only evident in US stocks pre-futures, while there is evidence of such trading in the small ('Other') markets post-futures. Positive feedback trading is reduced in all markets post-futures, with the exception of France and Germany where there is no evidence of such trading in either period. The results for the control stocks (table 4, panel B2) suggest that there has been a reduction in feedback trading in France, an increase in 'others' and no change in Germany, the UK and the US.[32] Finally, panels A3 and B3 in tables 4 and 5 suggest that there are some differences across industries, but there is no evidence that these are related to the onset of trading USFs.

In relation to the constant component of autocorrelation, φ_0, the findings for USF stocks (table 4, panel A1) are broadly similar to those for φ_1. Specifically, while the coefficient is significant for only 20% of stocks pre-futures, this falls to 11.25% post-futures. Antoniou et al. (2005) state that "… improvements in efficiency will most likely show up as reductions in φ_0 rather than changes in φ_1." (footnote 10, p.231). Examination of results for the control sample in table 4, panel B1, reveals that the percentage of stocks which exhibit a significant φ_0 pre-futures is slightly less than for USF stocks. However, the percentage rises for the control sample by over 11 percentage points in the post-futures period. The Z statistic demonstrates that there is a significant difference at the 1% level between the USF and control samples in the percentage of stocks for which there is a significant increase in φ_0 in the post-futures period. This suggests that trading in USFs has had a positive effect on the efficiency of the underlying market. Again, the results for USF stocks by country (table 4, panel A2) show differences, with big improvements in efficiency for the UK and the smaller ('Other') markets, while for control stocks the movements are opposite. Panels A3 and B3 of tables 4 and 5 again demonstrate industry effects.

(ii) Volatility

The impact of USF trading on stock market volatility can be assessed first through a comparison of the α_0 coefficient in the pre- and post-USF periods. An increase in α_0 would be an indication of increased unconditional volatility in the post-USF period. From table 4, panel A1, it is evident that the percentage of stocks with a significant α_0 has increased marginally post-futures (from

[32] In the UK there has been a slight reduction in negative feedback trading which is offset by an increase in positive feedback trading.

50% to 51.25%). In contrast, for the control sample, there has been a decrease (from 46.25% to 42.5%, table 4, panel B1). However, examination of panels A1 and B1 of table 5 reveals that the two samples (USF and control) have very similar patterns in terms of statistically significant changes. α_0 has shown a significant increase for 13.75% (12.5%) of USF (control) stocks, while the percentages exhibiting a decrease are 53.75% (58.75%). From panels A2 and B2 of tables 4 and 5 there is no clear pattern of country differences, while panels A3 and B3 of these tables suggest that again there are differences across industries, but that these are not related to the onset of futures trading.

Consideration of changes in α_1 and β from pre- to post-futures provides some initially surprising results. The number of stocks for which α_1 is statistically significant falls post-futures (table 4, panel A1), while the percentage of stocks exhibiting a statistically significant increase in α_1 post-futures (12.5%) in less than that exhibiting a decrease (15%) (table 5, panel A1). Similarly, the percentage of USF stocks for which there is a statistically significant increase in β (53.75%, see table 5, panel A1) is much greater than that for which there is a decrease (11.25%). This suggests that post-futures news has less impact and old innovations are more persistent. However, when control stocks are examined (table 5, panel B1), a very similar pattern of results emerges (α_1 increases (falls) for 16.25% (26.25%) of stocks, while β is significantly higher (lower) for 53.75% (18.75%) post-futures). Thus, to the extent that there is a change from the pre-futures to the post-futures period, this does not appear to be futures induced. These results clearly highlight the need for a control sample to be analysed to ensure that inappropriate inferences and policy recommendations are not reached concerning the impact of futures. If consideration had only been given to USF stocks a conclusion may have been incorrectly drawn that futures trading had impacted negatively on market dynamics and, hence, further regulation was warranted. Analysis of panels A2, B2, A3 and B3 of tables 4 and 5 provides no clear evidence of country effects, although again there are some differences by industry. However, there is no evidence that these differences are futures induced.[33] Again, this provides important insights about the control

[33] For example, for technology stocks β increases significantly post-futures for 11 of the 12 USF stocks and 10 control stocks. In contrast, for general & resources stocks only 6 out of 14 exhibit a significant increase for USF stocks and 5 out of 14 for the control sample.

sample. Not only is there a need to undertake analysis for a control sample, but it is important that the make up of the control sample is determined by a number of factors including industry.

The asymmetry coefficient (δ) shows marked changes from the pre- to post-futures period for USF stocks. The percentage of stocks for which δ is significant increases from 48.75% pre-futures to 83.75% post-futures (table 4, panel A1), while table 5, panel A1, demonstrates there is a significant increase in δ for 40% of all USF stocks. One explanation put forward in relation to δ is that asymmetries are related to noise trading (see Antoniou et al., 1998). Thus, increases in δ could be indicative of more movements away from fundamental value post-futures, although the evidence above in relation to φ_1 suggests that it is not feedback trading which has increased. However, it is again informative to examine the results for the control stocks. The pattern for these stocks (panel B of tables 4 and 5) is very similar to that for the USF stocks (33.75% exhibit a statistically significant increase in the value of δ post-futures), again suggesting any changes are unrelated to the introduction of USFs. Country differences are evident from panel A2 of the tables, with the US showing a small reduction in the percentage of USF stocks for which δ is significant (similar to Antoniou et al., 2005, which finds that δ decreases post-futures for the US), while other markets are subject to an increase. For control stocks even the US exhibits an increase in the number of stocks for which δ is significant. Once again, there are differences across industries, but no clear pattern of differences between USF and control stocks.

(iii) Robustness Tests

To check the robustness of the results, further estimations were undertaken. Specifically, two types of equally-weighted portfolios of stocks were created; those based on the country in which the underlying is traded (5 portfolios each for USF and control stocks) and those based on the industry of the stock (5 portfolios each for USF and control). Equations (5) and (6) were estimated for these 20 portfolios. Overall, the findings are qualitatively similar to the results presented in tables 3-5.[34] This finding, together with the results presented earlier, is interesting given that the markets in which the stocks underlying USFs are traded vary significantly. For example, there are major differences in the characteristics of market participants and the

[34] In the interests of brevity results for this and subsequent analysis are not reported, but are available on request.

regulation and size of the markets between the UK, the US, larger continental markets, such as France and Germany, and the smaller markets like Sweden and Switzerland. Concerns about the impact of derivative trading on the underlying market are arguably stronger for smaller, less liquid markets.[35] This is particularly true in relation to cross-border futures on underlyings traded in small markets, where the futures are traded in a major market such as LIFFE. However, results of the current study suggest such concerns are unfounded, since they indicate there is little systematic difference between the way small and large markets are affected by the introduction of USFs. For example, the USF country portfolio results show that as far as significant changes in coefficients are concerned, the movements in relation to the US market and the smaller ('Others') markets are the same for all coefficients except φ_1. For the smaller markets φ_1 was significantly higher post-futures at the 5% level, but it was not for markets in France, Germany, the UK and the US. However, the same result is found for control stocks. Results in relation to industry-based portfolios again suggest differences across industries in terms of feedback trading and autocorrelation. For example, for the USF stock portfolios φ_0 is significantly lower post-futures for the general and resources, consumer goods, and services industries, but not for the other industries. However, while industry differences in feedback trading are interesting and possibly worthy of further investigation, the overall pattern of results from tables 3-5 suggests that these industry-based differences are unrelated to futures trading.[36, 37]

Consideration is also given to the possibility of asymmetries in the feedback mechanism to investigate whether feedback trading is more intense during market declines. Hence, an additional term, $\varphi_2 | R_{t-1} |$, is added to equation (5) to capture any such possible effects[38]. In all cases the additional term is insignificant and results in relation to other coefficients are very similar. Finally, the feedback model was also estimated for windows of two years either side of

[35] Gulen and Mayhew (2000) empirically investigated the impact of stock index futures trading on 25 markets**.** They found very different results for highly developed and less developed countries.

[36] These industry based differences may be due to other factors unrelated to futures, the identification of which is beyond the scope of this paper.

[37] A comparison of differences between the 6 coefficients pre- and post-futures for the 20 portfolios was also undertaken based on total returns (including dividends). Results are qualitatively similar.

[38] $\varphi_2 | R_{t-1} |$ captures any asymmetry in the feedback trading mechanism. If φ_2 is positive and significant then feedback trading is more intense following negative returns. See also Antoniou et al. (2005), equation (9).

the introduction of futures for country and industry portfolios.[39] Generally, qualitative findings in relation to feedback trading for the two- and three-year windows are consistent, although there are some differences in relation to the findings for α_0. Specifically, post-futures α_0 is generally insignificantly different from its pre-futures value when a two-year window is used. However, findings are similar for both USF and control portfolios suggesting the conclusion that changes in α_0 are not futures induced remains valid. Thus, the general conclusions discussed earlier appear to be robust, given the range of additional tests undertaken.

5. CONCLUSION

This paper examines the impact of futures trading on underlying market dynamics using a model which takes account not only of volatility, but also the extent to which derivatives promote or inhibit feedback trading. By examining the behaviour of the underlying markets for stocks on which USFs are traded, it is possible to gain insights not previously possible. Specifically, since USFs are listed on a range of stocks traded on a number of markets with different characteristics and across a range of industries, it is possible to identify the extent to which there are country/market or industry specific effects. This is particularly important given the cross-border nature of USFs and concerns about futures listing might be greater for stocks listed in less liquid, smaller markets. Furthermore, if derivatives do have an impact on the cash market, such effects are more likely to be evident in the behaviour of individual stocks which are tradable, rather than in the market dynamics of an index which cannot be directly traded. In addition, given the nature of USFs it is possible to address endogeneity issues inherent in many previous studies, by constructing a control sample based on the factors affecting the listing decision, and to examine more than one event date within a given market. This means that results provide more reliable and wider ranging insights into the impact of derivative trading on the underlying.

[39] The method of trading changed for USFs written on UK based stocks at the end of November 2003, with the introduction of the MATCH facility. See the LIFFE website for details. By estimating the model for 2 years either side of the introduction of USFs the sample period excludes the change to the MATCH system and allows determination of the extent to which the change impacted on the findings.

There is clear evidence that the level of feedback trading is low in both the pre-futures and post-futures periods for USF and control stocks, with the pre-futures period exhibiting marginally more feedback trading. To the extent that there is a change post-futures, there is a greater reduction in feedback trading for USF stocks than for control stocks. Thus, any effect of futures on feedback trading appears to be small, but beneficial. For USF stocks changes in relation to the impact of news on volatility (α_1) and the persistence of innovations (β) and the extent to which volatility is affected asymmetrically by good and bad news (δ) look initially surprising. α_1 tends to fall post-futures, and β and δ rise, suggesting that futures are having a destabilising impact. However, when these coefficients are examined for control stocks, the same picture is evident, suggesting any changes in these parameters from the pre- to the post-futures period are not futures related. Equally, unconditional volatility (α_0) behaves in a similar manner for both USF and control stocks. These findings demonstrate the importance of undertaking estimations not only for stocks on which USFs are written, but also for control stocks. In the absence of the results for control stocks, inappropriate policy conclusions may have been reached. Specifically, the evidence in relation to α_1, β and δ suggests that post-futures there has been a negative effect on market dynamics and, hence, further regulation of USFs may have been called for. However, by also examining control stocks selected on the basis of modelling the listing decision, it is clear that such calls are unwarranted.

Examination of any possible differential impact by country suggests that systematic differences between the way small and large markets are affected by the introduction of USFs do not exist. Thus, concerns that USFs might impact (more) negatively on smaller, less liquid markets appear unfounded. The results also suggest that there are clear differences in the pattern of market dynamics between industries, but that such differences are not futures induced. Examination of why such differences exist is worthy of further study, but is beyond the scope of this paper. However, the results in relation to industry differences clearly demonstrate the need to construct a control sample in a way which directly takes account of the industry in which the stock is based.

Overall, the findings provide compelling and useful insights and suggest that the listing of USFs has not impacted negatively on the underlying markets. It should, of course, be recognised that in all the markets considered here index futures existed prior to the introduction of USFs. Thus, it might be expected that these stocks would be less affected by the introduction of SSFs. Nonetheless, to the extent that USFs have impacted on feedback trading and wider market dynamics, the influence appears to have been positive, leading to a small reduction in feedback trading and improved efficiency.

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Table 1
Logit Models of USF Listing Choice

Variable	Model A	Model B	Model C	Model D
Intercept	-3.7343 ***	-6.0529 ***	-6.6091 ***	-8.4017 ***
	(-10.800)	(-11.400)	(-10.400)	(-11.200)
VOL	0.0092 ***	0.0092 ***	0.0128 ***	0.0124 ***
	(7.440)	(7.080)	(8.810)	(8.280)
STD	-0.4793 ***	-0.5000 ***	-0.5498 ***	-0.5685 ***
	(-3.520)	(-3.460)	(-3.790)	(-3.790)
SVOL		0.4040		0.3733
		(1.160)		(1.010)
SSTD		1.6833 ***		1.4740 ***
		(5.790)		(4.780)
SIZE	0.0016 ***	0.0017 ***	0.0015 ***	0.0016 ***
	(8.460)	(8.590)	(7.870)	(7.850)
MKT			0.2764 ***	0.2192 ***
			(5.770)	(4.540)
IND			0.0149 ***	0.0157 ***
			(3.510)	(3.610)
Number of Observations	3872	3872	3872	3872
Percent Classified Correctly	85.77%	85.56%	82.49%	85.18%
Percent Classified Incorrectly	14.23%	14.44%	17.51%	14.82%

Notes:
This table presents the results from logistic estimation of USF listing as a function of characteristics of the underlying stocks (t-value in parentheses).

$$\log(\frac{p}{1-p}) = \alpha_0 + \alpha_1 VOL + \alpha_2 STD + \alpha_3 SVOL + \alpha_4 SSTD + \alpha_5 SIZE + \alpha_6 MKT + \alpha_7 IND + \varepsilon \qquad (7)$$

The sample includes all the firms that meet the eligibility criteria by the time of listing (e.g. January 2001). If a firm is listed by LIFFE, the dependent variable is 1, otherwise 0. The variables VOL and STD are measured as the average daily trading volume (VOL) and standard deviation (STD) of daily returns on the underlying stock over the prior 250 trading days. The variables SVOL and SSTD are ratios of 30-day to 250-day prior trading volume and standard deviation. The variable SIZE is the market capitalisation of the firm. MKT and IND are market and industry indicators respectively. *, ** and *** denote significant at 10%, 5% and 1% respectively.

Table 2
Summary Statistics of Portfolios Returns

	USF Stocks								Control Stocks							
	μ	σ	S	K	JB	LB(5)	LB²(5)	ARCH	μ	σ	S	K	JB	LB(5)	LB²(5)	ARCH
Panel A : Country																
France (9)	-0.013	1.238	-0.117*	2.005***	265.580***	26.473***	138.316***	16.625***	0.016	1.004	0.005	1.172***	89.628***	5.982	104.372***	15.151***
Germany (12)	-0.022	1.113	-0.065	0.700***	33.068***	11.113**	141.092***	15.955***	-0.033	1.021	-0.029	1.029***	69.243***	9.134	44.196***	5.853**
UK (17)	-0.007	0.854	-0.014	1.080***	76.129***	31.150***	112.697***	25.588***	-0.015	0.797	-0.118*	1.233***	102.770***	19.539***	28.615***	5.535**
US (16)	0.032	1.357	0.124**	0.882***	54.788***	0.786	113.163***	37.962***	0.031	1.358	-0.030	0.930***	56.658***	6.016	42.958***	13.152***
Others (26)	-0.003	0.902	0.006	1.359***	120.420***	15.381***	219.115***	41.580***	-0.001	0.883	0.080	1.471***	142.800***	25.197***	260.849***	39.243***
Panel B : Industry																
Services (16)	-0.005	1.016	-0.143**	2.638***	459.180***	21.938***	66.573***	2.842*	0.002	0.772	-0.033	1.155***	87.305***	14.231**	42.695***	13.893***
Consumer Goods (13)	-0.001	0.845	-0.127**	0.690***	35.197***	20.272***	112.593***	29.568***	0.024	0.756	-0.027	0.653***	28.032***	14.568**	135.889***	13.756***
Technology (12)	0.023	1.663	0.136**	1.098***	83.397***	2.346	129.339***	54.250***	0.016	1.730	-0.038	0.446***	13.322***	4.541	44.833***	15.379***
Financial (25)	-0.011	0.927	-0.014	1.593***	165.500***	38.192***	230.591***	39.055***	-0.029	0.865	-0.056	1.798***	211.560***	33.187***	171.087***	29.162***
General & Resources (14)	0.003	0.867	-0.156**	0.546***	25.773***	16.082***	103.473***	18.932***	0.009	0.921	0.021	0.455***	13.598***	5.907	38.099***	5.571**

Notes: Summary statistics of portfolios of USF and control stocks, based on country (panel A) and industry sector (panel B) are provided. The number of stocks in each portfolio is shown in parentheses. μ, σ, S, K, and JB, are the sample mean, standard deviation, skewness, excess kurtosis and Jarque-Bera normality test respectively. LB(5) and LB²(5) are the Ljung-Box χ^2 statistics for 5 lags calculated for returns and squared returns. ARCH is the Lagrange Multiplier test for ARCH effects and distributed as χ^2 with 1 degree of freedom. *, ** and *** denote significant at 10%, 5% and 1% respectively.

Table 3

Mean Value of Key Coefficients from Equations (5) and (6) in the Pre- and Post-Futures Periods

	φ_0		φ_1 (positive)		φ_1 (negative)		α_0		α_1		β		δ	
	Pre-Futures	**Post-Futures**	**Pre-Futures**	**Post-Futures**	**Pre-Futures**	**Post-Futures**	**Pre-Futures**	**Post-Futures**	**Pre-Futures**	**Post-Futures**	**Pre-Futures**	**Post-Futures**	**Pre-Futures**	**Post-Futures**
Panel A : USF stocks														
A1 : Total														
Total (80)	0.059	-0.037	0.009	0.007	-0.015	-0.006	0.430	0.079	0.041	0.026	0.859	0.914	0.090	0.105
		<0.000>***		<0.265>		<0.005>***		<0.000>***		<0.000>***		<0.000>***		<0.073>*
A2 : Country														
France (9)	0.085	-0.034	0.008	0.007	-0.018	-0.004	0.390	0.085	0.041	0.023	0.858	0.904	0.053	0.120
Germany (12)	0.046	-0.031	0.006	0.002	-0.005	-0.005	0.345	0.073	0.036	0.022	0.883	0.924	0.072	0.114
UK (17)	0.106	-0.036	0.008	0.009	-0.025	-0.012	0.364	0.098	0.048	0.031	0.859	0.892	0.065	0.114
US (16)	-0.042	-0.079	0.014	0.011	-0.007	-0.003	0.828	0.082	0.043	0.022	0.843	0.939	0.140	0.064
Others (26)	0.088	-0.014	0.008	0.006	-0.015	-0.004	0.283	0.066	0.039	0.028	0.858	0.912	0.098	0.114
A3 : Industry														
Services (16)	0.112	-0.020	0.020	0.008	-0.012	-0.011	0.428	0.058	0.066	0.022	0.848	0.927	0.082	0.101
Consumer Goods (13)	0.095	-0.056	0.012	0.018	-0.025	-0.009	0.581	0.102	0.040	0.033	0.809	0.897	0.095	0.085
Technology (12)	-0.006	-0.032	0.001	0.002	-0.003	-0.004	0.890	0.062	0.048	0.017	0.853	0.968	0.119	0.053
Financial (25)	0.041	-0.020	0.006	0.005	-0.013	-0.003	0.236	0.095	0.031	0.033	0.886	0.890	0.082	0.140
General & Resources (14)	0.053	-0.072	0.013	0.006	-0.022	-0.006	0.246	0.068	0.028	0.020	0.876	0.912	0.085	0.109
Panel B : Control stocks														
B1 : Total														
Total (80)	0.032	-0.015	0.006	0.009	-0.014	-0.010	0.501	0.2221	0.054	0.044	0.861	0.897	0.081	0.085
		<0.001>***		<0.169>		<0.008>***		<0.000>***		<0.001>***		<0.000>***		<0.368>
B2 : Country														
France (9)	0.060	-0.045	0.008	0.004	-0.020	-0.010	0.557	0.054	0.043	0.015	0.850	0.9222	0.078	0 .106
Germany (12)	0.034	0.014	0.005	0.008	-0.015	-0.004	0.283	0.064	0.046	0.059	0.879	0.897	0.071	0.088
UK (17)	-0.001	-0.042	0.005	0.014	-0.018	-0.015	0.357	0.131	0.051	0.043	0.872	0.895	0.074	0.085
US (16)	0.060	0.021	0.002	0.005	-0.008	-0022	1.040	0.079	0.034	0.014	0.872	0.948	0.110	0.073
Others (26)	0.027	-0.023	0.008	0.010	-0.016	-0.004	0.344	0.497	0.076	0.066	0.872	0.858	0.073	0.085
B3 : Industry														
Services (16)	-0.007	-0.048	0.007	0.009	-0.019	-0.005	0.347	0.152	0.064	0.045	0.854	0.885	0.079	0.092
Consumer Goods (13)	0.028	-0.039	0.007	0.011	-0.023	-0.029	0.304	0.075	0.067	0.027	0.864	0.910	0.060	0.087
Technology (12)	0.029	0.024	0.001	0.002	-0.003	-0.004	1.303	0.069	0.024	0.018	0.866	0.963	0.130	0.048
Financial (25)	0.043	0.007	0.006	0.013	-0.014	-0.008	0.249	0.118	0.062	0.049	0.868	0.886	0.070	0.106
General & Resources (14)	0.066	-0.029	0.005	0.005	-0.016	-0.011	0.622	0.748	0.045	0.071	0.849	0.861	0.079	0.071

Notes: This table summarises the results from estimating the feedback trading model (Eq. 5 and 6) for each USF and control stock in both the pre- and post-futures periods:

$$R_{it} = \alpha + \mu\sigma_t^2 + (\varphi_0 + \varphi_1\sigma_t^2)R_{it-1} + \varepsilon_t \qquad \varepsilon_t \sim GED(0,\sigma_t^2) \qquad (5)$$

$$\sigma_t^2 = \alpha_0 + \alpha_1\varepsilon_{t-1}^2 + \beta\sigma_{t-1}^2 + \delta X_{t-1}\varepsilon_{t-1}^2 \qquad (6)$$

The mean value of each key coefficient is reported. Panel A1 shows results for the whole USF sample, panel A2 provides the figures broken down by the country in which the underlying stocks being traded, while panel A3 provides the same information by industry. The number of stocks in each subsample are shown in parentheses. Panel B presents the same information for control sample. < > is the P-values of Kruskal-Wallis test which examines whether the post-futures coefficients are significantly different from the pre-futures coefficients. Test statistics are reported for total samples only. *, **, *** indicate significant at 10%, 5% and 1% level, respectively.

Table 4

Percentage of Statistically Significant Coefficients from Equations (5) and (6) in the Pre- and Post-Futures Periods

	φ_0		φ_1 (positive)		φ_1 (negative)		α_0		α_1		β		δ	
	Pre-Futures	**Post-Futures**	**Pre-Futures**	**Post-Futures**	**Pre-Futures**	**Post-Futures**	**Pre-Futures**	**Post-Futures**	**Pre-Futures**	**Post-Futures**	**Pre-Futures**	**Post-Futures**	**Pre-Futures**	**Post-Futures**
Panel A : USF stocks														
A1 : Total														
Total (80)	20.00	11.25	1.25	1.25	5.00	1.25	50.00	51.25	25.00	17.50	100.00	100.00	48.75	83.75
A2 : Country														
France (9)	11.11	22.22	0.00	0.00	0.00	0.00	44.44	66.67	22.22	11.11	100.00	100.00	44.44	88.89
Germany (12)	8.33	8.33	0.00	0.00	0.00	0.00	50.00	58.33	33.33	25.00	100.00	100.00	33.33	91.67
UK (17)	23.53	5.88	0.00	0.00	11.76	5.88	35.29	64.71	23.53	11.76	100.00	100.00	41.18	82.35
US (16)	12.50	18.75	6.25	0.00	6.25	0.00	68.75	31.25	31.25	25.00	100.00	100.00	75.00	68.75
Others (26)	30.77	7.69	0.00	3.85	3.85	0.00	50.00	46.15	19.23	15.38	100.00	100.00	46.15	88.46
A3 : Industry														
Services (16)	31.25	6.25	6.25	0.00	12.50	6.25	37.50	31.25	56.25	6.25	100.00	100.00	25.00	81.25
Consumer Goods (13)	15.38	15.38	0.00	0.00	7.69	0.00	38.46	46.15	23.08	15.38	100.00	100.00	30.77	61.54
Technology (12)	8.33	0.00	0.00	0.00	8.33	0.00	75.00	8.33	41.67	41.67	100.00	100.00	66.67	83.33
Financial (25)	28.00	4.00	0.00	4.00	0.00	0.00	56.00	84.00	12.00	20.00	100.00	100.00	64.00	92.00
General & Resources (14)	7.14	35.71	0.00	0.00	0.00	0.00	42.86	57.14	0.00	7.14	100.00	100.00	50.00	92.86
Panel B : Control stocks														
B1 : Total														
Total (80)	17.50	28.75	3.75	3.75	7.50	7.50	46.25	42.50	41.25	26.25	100.00	100.00	40.00	71.25
B2 : Country														
France (9)	22.22	33.33	0.00	0.00	22.22	0.00	66.67	11.11	22.22	0.00	100.00	100.00	44.44	88.89
Germany (12)	8.33	16.67	0.00	0.00	0.00	0.00	8.33	41.67	50.00	41.67	100.00	100.00	58.33	83.33
UK (17)	23.53	35.29	11.76	5.88	0.00	5.88	35.29	41.18	23.53	29.41	100.00	100.00	29.41	70.59
US (16)	18.75	12.50	0.00	0.00	12.50	12.50	56.25	31.25	31.25	18.75	100.00	100.00	56.25	81.25
Others (26)	15.38	38.46	3.85	7.69	7.69	11.54	57.69	61.54	61.54	30.77	100.00	100.00	26.92	53.85
B3 : Industry														
Services (16)	18.75	25.00	12.50	0.00	6.25	12.50	43.75	37.50	56.25	31.25	100.00	100.00	31.25	62.50
Consumer Goods (13)	30.77	38.46	0.00	7.69	0.00	7.69	53.85	53.85	53.85	15.38	100.00	100.00	23.08	84.62
Technology (12)	0.00	8.33	0.00	0.00	16.67	8.33	66.67	0.00	16.67	25.00	100.00	100.00	75.00	58.33
Financial (25)	12.00	32.00	4.00	4.00	8.00	8.00	48.00	56.00	56.00	28.00	100.00	100.00	48.00	76.00
General & Resources (14)	35.71	35.71	0.00	7.14	7.14	0.00	21.43	50.00	7.14	28.57	100.00	100.00	21.43	71.43

Notes: This table summarises the estimates of feedback trading model (Eq. 5 and 6) for each USF and control stock in both the pre- and post-futures periods:

$$R_{it} = \alpha + \mu\sigma_t^2 + (\varphi_0 + \varphi_1\sigma_t^2)R_{it-1} + \varepsilon_t \qquad \varepsilon_t \sim GED(0,\sigma_t^2) \qquad (5)$$

$$\sigma_t^2 = \alpha_0 + \alpha_1\varepsilon_{t-1}^2 + \beta\sigma_{t-1}^2 + \delta X_{t-1}\varepsilon_{t-1}^2 \qquad (6)$$

The percentage of stocks for which each key coefficient is statistically significant at the 5% level are reported. Panel A1 shows results for the whole USF sample, panel A2 provides the figures broken down by the country in which the underlying stocks are traded, while panel A3 provides the same information by industry. The number of stocks in each subsample are shown in parentheses. Panel B presents the same information for the control sample.

Table 5

Test of Significance of Differences in the Coefficients from the Pre-Futures to the Post-Futures Period by Direction of Change

	φ_0		φ_1 (positive)		φ_1 (negative)		α_0		α_1		β		δ	
	Sign. Increase	**Sign. Decrease**	**Sign. Increase**	**Sign. Decrease**	**Sign. Increase**	**Sign. Decrease**	**Sign. Increase**	**Sign. Decrease**	**Sign. Increase**	**Sign. Decrease**	**Sign. Increase**	**Sign. Decrease**	**Sign. Increase**	**Sign. Decrease**
Panel A : USF stocks														
A1 : Total														
Total (80)	1.25	26.25	0.00	1.25	10.00	1.25	13.75	53.75	12.50	15.00	53.75	11.25	40.00	20.00
A2 : Country														
France (9)	0.00	44.44	0.00	0.00	11.11	0.00	22.22	66.67	11.11	22.22	55.56	22.22	55.56	0.00
Germany (12)	0.00	8.33	0.00	0.00	0.00	0.00	25.00	41.67	16.67	16.67	41.67	16.67	50.00	8.33
UK (17)	5.88	29.41	0.00	0.00	17.65	5.88	11.76	41.18	5.88	23.53	41.18	23.53	47.06	0.00
US (16)	0.00	18.75	0.00	6.25	6.25	0.00	12.50	68.75	18.75	12.50	75.00	0.00	12.50	62.50
Others (26)	0.00	30.77	0.00	0.00	11.54	0.00	7.69	53.85	11.54	7.69	53.85	3.85	42.31	19.23
A3 : Industry														
Services (16)	0.00	37.50	0.00	6.25	12.50	6.25	12.50	50.00	0.00	37.50	56.25	6.25	56.25	18.75
Consumer Goods (13)	0.00	15.38	0.00	0.00	15.38	0.00	7.69	46.15	15.38	15.38	69.23	7.69	46.15	30.77
Technology (12)	0.00	8.33	0.00	0.00	0.00	0.00	0.00	83.33	33.33	25.00	91.67	0.00	25.00	66.67
Financial (25)	4.00	24.00	0.00	0.00	12.00	0.00	24.00	48.00	12.00	4.00	32.00	20.00	40.00	4.00
General & Resources (14)	0.00	42.86	0.00	0.00	7.14	0.00	14.29	50.00	7.14	0.00	42.86	14.29	28.57	0.00
Panel B : Control stocks														
B1 : Total														
Total (80)	13.75	26.25	3.75	2.50	6.25	2.50	12.50	58.75	16.25	26.25	53.75	18.75	33.75	15.00
B2 : Country														
France (9)	22.22	22.22	0.00	0.00	33.33	0.00	0.00	66.67	0.00	22.22	77.78	11.11	55.56	0.00
Germany (12)	8.33	8.33	0.00	0.00	0.00	0.00	16.67	50.00	33.33	8.33	33.33	41.67	16.67	8.33
UK (17)	11.76	29.41	5.88	0.00	0.00	0.00	11.76	52.94	17.65	23.53	41.18	17.65	29.41	5.88
US (16)	6.25	18.75	0.00	0.00	6.25	12.50	12.50	75.00	6.25	25.00	68.75	6.25	25.00	37.50
Others (26)	19.23	38.46	7.69	7.69	3.85	0.00	15.38	53.85	19.23	38.46	53.85	19.23	42.31	15.38
B3 : Industry														
Services (16)	12.50	31.25	0.00	12.50	12.50	0.00	12.50	56.25	18.75	31.25	56.25	18.75	37.50	18.75
Consumer Goods (13)	7.69	46.15	7.69	0.00	7.69	7.69	23.08	61.54	7.69	38.46	53.85	23.08	61.54	7.69
Technology (12)	8.33	0.00	0.00	0.00	0.00	8.33	0.00	75.00	16.67	16.67	83.33	0.00	8.33	50.00
Financial (25)	20.00	16.00	4.00	0.00	0.00	0.00	12.00	48.00	12.00	32.00	48.00	28.00	28.00	4.00
General & Resources (14)	14.29	42.86	7.14	0.00	14.29	0.00	14.29	64.29	28.57	7.14	35.71	14.29	35.71	7.14

Notes: This table summarises the estimates of Wald statistics on the equality of the feedback trading model coefficients (Eq. 5 and 6) for pre- and post-futures periods for USF and control stocks:

$$R_{it} = \alpha + \mu\sigma_t^2 + (\varphi_0 + \varphi_1\sigma_t^2)R_{it-1} + \varepsilon_t \qquad \varepsilon_t \sim GED(0, \sigma_t^2) \qquad (5)$$

$$\sigma_t^2 = \alpha_0 + \alpha_1\varepsilon_{t-1}^2 + \beta\sigma_{t-1}^2 + \delta X_{t-1}\varepsilon_{t-1}^2 \qquad (6)$$

The percentage of stocks for which each key coefficient is significantly changed (increase or decrease) at the 5% level are reported. Panel A1 shows results for the whole USF sample, panel A2 provides the figures broken down by the country in which the underlying stocks are traded, while panel A3 provides the same information by industry. The number of stocks in each subsample are shown in parentheses. Panel B presents the same information for the control sample.